Sept. 27, 1960 R. C. SMITH 2,954,028

APPARATUS FOR ADMINISTERING PARENTERAL FLUIDS

Filed Oct. 26, 1955 2 Sheets-Sheet 1

FIG.1.

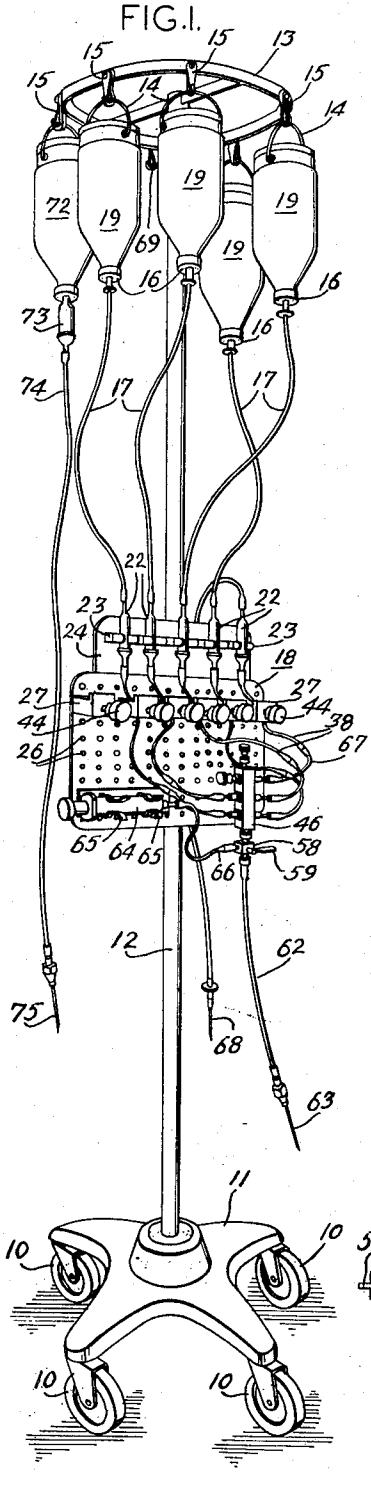

FIG.4.

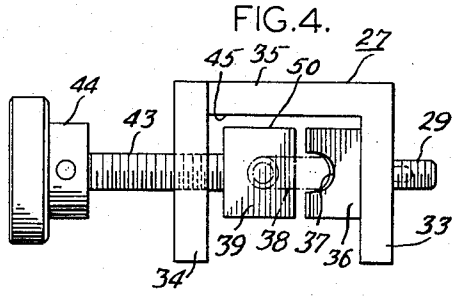

FIG.5.

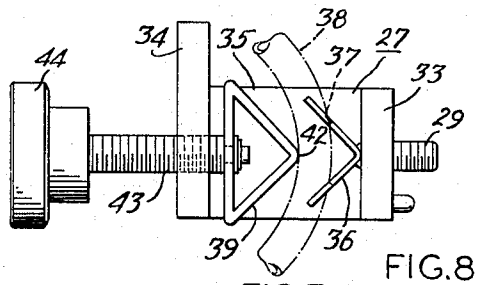

FIG.6.

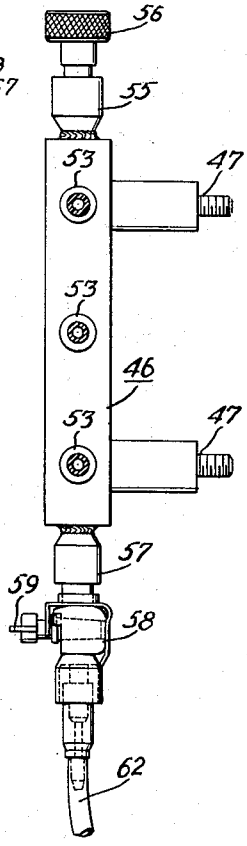

FIG.7.

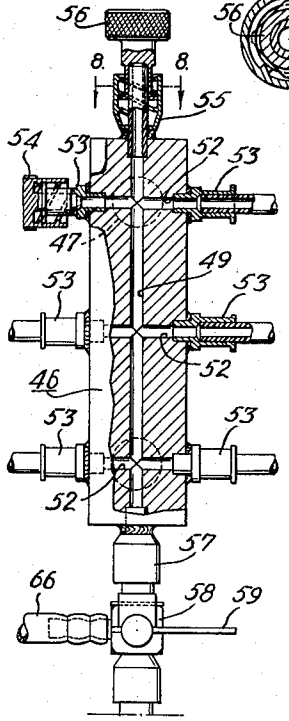

FIG.8.

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Filed Oct. 26, 1955 2 Sheets-Sheet 2

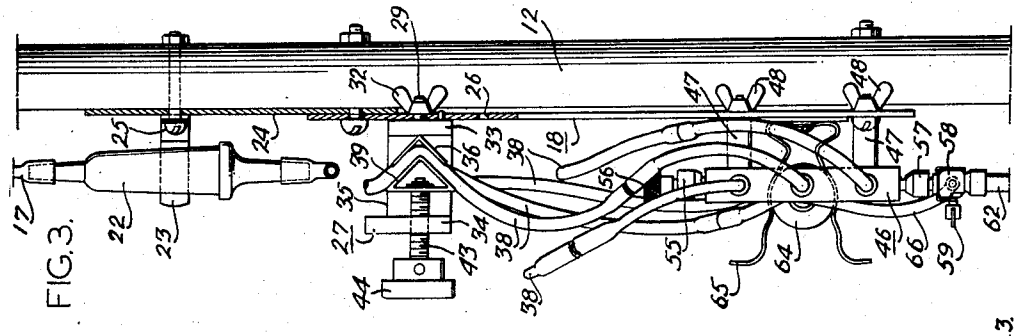

FIG. 3.

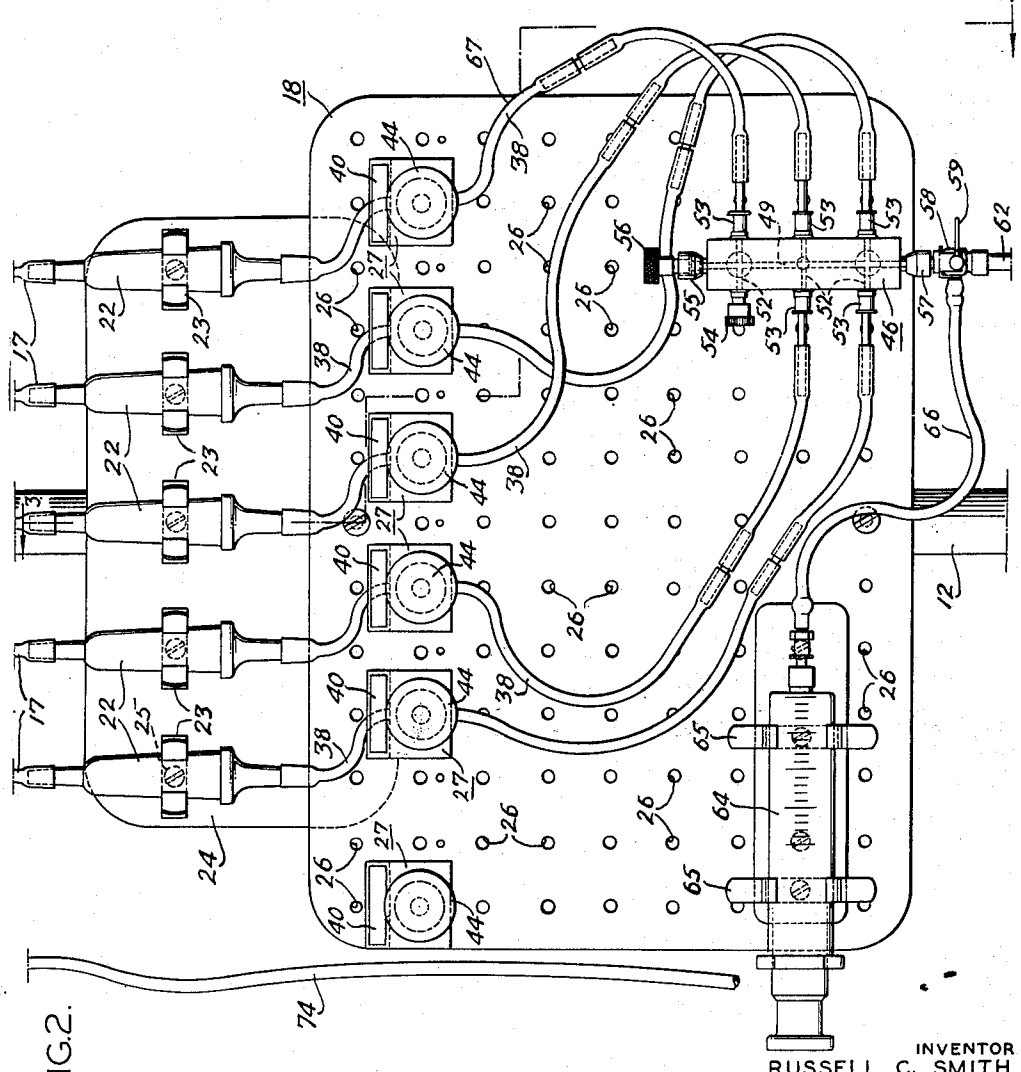

FIG. 2.

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APPARATUS FOR ADMINISTERING PARENTERAL FLUIDS

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10 Claims. (Cl. 128—214)

This invention relates to the administration of fluids through a surgical needle into the body of a patient, and is concerned especially with the provision of improved apparatus for control of such administration incident to the performance of surgical operations.

While vast forward strides have been made in recent years in the development of solutions and mixtures of solutions to be administered, including anesthetics, analeptics, vasopressors, hypotensors, muscle relaxants, vitamins and amino acids, procaine, epinephrine, etc., the mechanical art of administration has by no means kept pace with these scientific developments. A basic object of this invention has been to close this gap.

Considering more specifically the shortcomings of the practical art of administering such fluids intravenously in surgery, a more or less standard type of infusion set has evolved, consisting characteristically of a bottle of solution, rubber or plastic tubing connecting the bottle to the needle, a drip indicator and a means of flow control comprising a pinch clip or cock. When a plurality of fluids were to be administered simultaneously, it has been necessary to use a separate needle, tubing and venipuncture for each solution, or to use one or more Y tubes. Two-, three- and even four-way stop cocks have been employed, and very frequently the flow from two or more solution bottles has been combined by inserting the needle of one infusion set into the tubing of another. The resulting needle holes frequently leak, resulting in an unreliable and unpleasant control situation.

The methods of flow control thus employed are also lacking in the fundamentals of accurate control and economical functioning. The pinch clips are usually secured to the tubing itself, and are incapable of providing the desired delicacy of flow control, especially with the critical dosages required in administration of some of the newer agents. Another difficulty lies in the fact that, with these prior art control methods, it was necessary to discard the entire infusion set and remaining unused fluids, after the completion of an operation, and then set up new solutions, tubing, syringes, etc., for the next patient, in order to avoid the possibility of contamination. This has not only entailed wastage and expense in regard to materials and supplies, but even more seriously, has consumed considerable time that might theoretically be much more profitably employed.

It has been the practice to secure the syringe by taping or otherwise to the operating table, and these mountings have lacked the desired sturdiness and dependability.

Perhaps even more serious than these disadvantages has been the difficulty in adjusting the parenteral fluid administration rapidly to emergency conditions, and the confusion sometimes encountered in the effort to adjust promptly to the need for a change in rate of flow, or of the parenteral fluids to be administered. For example, with the bottle mounted in a position high above the operating table, it has been difficult to observe the drip sight glass adjacent the neck of the bottle, and to control the pinch clips in response to such observation, and thereby

control the infusion rate. An even more serious situation arises when it is desired to administer a fluid which is not immediately available.

A further problem has been that it has been difficult to maintain these supplies and the associated equipment in position for convenient access to the operating bed, where this might be in a variety of locations.

This invention has had as its primary object the provision of an infusion apparatus by which all of these disadvantages are obviated.

An important object has been to provide an apparatus which is portable and highly flexible by way of adjustment to various locations and conditions, for mounting and maintaining the various parenteral fluids which may be required in position for ready access by the anesthetist.

A further object has been to provide such an apparatus with the various solution bottles located and interconnected in position for almost instantaneous adjustment to conditions as they arise, by way of change of liquids to be infused, or change in rate or ratio of flow of the liquid or liquids.

A further object has been to provide such an apparatus in which only a minimum of equipment or parenteral solution needs to be discarded between operations, and in which the major part remains set up and ready for use, during a number of successive operations, requiring only a minimum of necessary adjustments to provide control of fluids and their proportions to be used in such successive operations.

A further object has been to provide in such an apparatus equipment for controlling the flow of the liquids which is sturdy, conveniently located, and fully reliable and delicately responsive.

A further object has been to provide an apparatus of this type in which the rates at which the liquids are fed through the apparatus for infusion may be observed conveniently and at close range.

A further object has been to provide, in conjunction with such an apparatus, a convenient and sturdy mounting for a syringe, with connections from the syringe to certain portions of the apparatus through which anesthetic, etc., solutions are infused, so that injection of liquids from the syringe may be attained through these same connections.

Still further objects and advantages of the invention, and the manner in which they have been attained, will be evident from reading of the following detailed description in the light of the attached drawing, in which,

Figure 1 is a perspective view of apparatus constructed and mounted in accordance with a preferred embodiment of the invention,

Figure 2 is a detailed front view of the mounting constituting the central portion of the apparatus, and of the elements secured thereto,

Figure 3 is a detailed view, partly in side elevation and partly in cross-section, taken from the line 3—3 of Figure 2,

Figure 4 is a plan view of one of the tube securing and adjusting clamps,

Figure 5 is a side elevation of the clamp of Figure 4, with the tubing illustrated in broken lines in position therein,

Figure 6 is a side elevation, partly in section, of the manifold comprising the central element of the invention,

Figure 7 is a view partly in cross-section and partly in elevation, taken at right angles to Figure 6, and

Figure 8 is a cross-section on the line 8—8 of Figure 7.

As illustrated in the drawing, the apparatus comprises a portable supporting structure mounted upon wheels or casters **10**, and comprising a base plate **11** on which is mounted a post **12** carrying at its upper end a ring **13**. The individual bottles **19** carrying the parenteral liquids

are secured through handles 14 to clips 15 mounted upon the ring 13, and the necks of these bottles are connected, through caps or fittings 16 and individual flexible tubes 17, which may be of polyethylene or other plastic material, to connections mounted upon a rigid panel 18.

A plurality of drip sight glasses 22 are interconnected with the lower ends of the individual tubes 17, and are secured by clips 23 to a panel 24, which may be integral with the upper end of the panel 18 or otherwise rigidly secured to that panel or to the post 12. These panels, and the individual drip sight clips, may be secured in desired position upon the post 12 by means of bolts and screws 25.

A large number of holes 26 are formed through the face of the panel 18, and these holes may be formed in a rectangular pattern and spaced apart about one inch in each direction, as illustrated. A number of U-shaped brackets 27 are secured through these holes in horizontal alignment with each other by means of bolts 29 extending through the perforations 26 and secured against the opposite side of the panel by wing nuts 32. Each of these brackets comprises a laterally extending rear arm 33 and a similarly extending forward arm 34 interconnected by a central portion 35, and the rear clamping member 36 is in the form of a V-shaped member with its apex secured to the forward surface of arm 33 and its arm extending angularly upwardly and downwardly from a horizontal plane, as illustrated. Each of these arms has, at its forward end, a curved notch 37 which receives interconnecting tubing members 38 which extend downwardly from the lower ends of the sight glasses 22 to an interconnection with manifold 46 to be discussed hereinafter.

Male clamping members 39 are provided for co-action with the V-shaped female clamping members 36, and these male clamping members are swiveled upon the ends of studs 43 threaded through the bracket arms 34 and actuated by operating knobs or handles 44, so that the apices 42 of these male clamping members tend to pinch the tubing members 38 progressively as they are brought home through operation of knobs 44. As will be seen from Figure 5, the tubing members 38 are held in position by the opposed clamping members even when no clamping pressure is exerted, and as knob 44 is turned to move the apex 42 rearwardly, the tubing will be progressively pinched to exactly the required degree, to shut off liquid flow, or to permit it to occur in controlled amount. By reference to Figures 4 and 5, it will be evident that the inside lateral faces 45 of the central portions 35 of the brackets 27 are in close proximity to the opposing surfaces 50 of the clamping members 39, and this provides an abutment and insures that these members will always be positioned in the desired relationship to their complemental clamping members 36, in spite of the fact that they are mounted in swiveled relationship upon the studs 43. Plates or labels 40 may be secured upon the upper parts of the faces of arms 34 of brackets 27 to indicate to the anesthetist the solution whose flow is controlled by each clamping fixture.

One or more manifolds 46 are also secured in desired position by studs 47 (Figures 3 and 6) and wing nuts 48 through selected holes in clamped relationship against the face of panel 18 below the locations of the clamps, and the manifold comprises a vertical duct or passage 49 extending through its entire length, and a plurality of horizontal passages 52 extending across the width thereof and interconnected by the vertical passage 49. Female Luer fittings 53 or their equivalent are secured to the manifold at the outer ends of the passages 52, and these fittings are normally closed, when a particular branch of the horizontal passages 52 is not to be used, by complemental male fittings or caps 54. A pair of complemental Luer fittings 55 and 56 is also provided at the upper end of the vertical passage 49.

A terminal coupling 57 is connected to the lower end of passage 49, and this coupling includes a valve 58 which may be operated by handle 59 for interconnection of flexible terminal tubing 62 and needle 63 with the manifold 46 or with a syringe 64 which is secured in desired position upon panel 18 by clips 65, and interconnected with valve 58 through tubing 66. In use of the apparatus, it may be set up as illustrated in Figure 1 at the start of a series of operations which may be successively performed during the entire day. Solution bottles containing the fluids which are likely to be required during the sequence of operations are mounted as illustrated, four of these bottles being interconnected to sight glasses 22 and the four intermediate brackets and clamping members 27, 36, 39, as illustrated in Figures 1 and 5. Tubing connections may also be made to the Luer fittings of manifold 46 which are not expected to be used immediately, as illustrated at 67 in Figure 1, so that interconnection of this tubing may rapidly be made through its needle 68 to a bottle which may be set up on clip 69 of ring 13. Further bottles may also be set up on ring 13 in more or less conventional fashion, as illustrated in connection with the bottle 72 which may contain blood plasma, and be provided with a drip sight 73 and tubing 74 interconnecting it with a separate needle 75.

The intermediate tubing connections 38 may be made to any desired number of the manifold connections, and the others closed off by male fittings 54. In the typical situation illustrated, the male Luer fitting at the upper left of manifold 46 may be removed rapidly and replaced by a connection from a further bottle mounted and interconnected with this fitting in the same manner as the interconnections are made to the remaining fittings, and this same adaptability is available regardless of the number of fittings in use at any given time.

With the apparatus set up in the manner illustrated, the anesthetist has only to operate the knobs 44 with valve 58 in proper position, to administer a desired fluid or mixture of fluids. Since the drip sights 22 and indicia 40 are mounted at just about eye level, the amount of fluid being administered can in each case be readily observed and instantaneous adjustments can be made in response to observation as the operation progresses. As the condition of the patient changes, the administration of fluids may rapidly be changed from one fluid to another, or from one proportion to another, simply by making the desired adjustments of the knobs 44 and observing the consequences of these adjustments through the drip sights. If, at any time, it be desired to inject fluid through the syringe 64 rather than through the manifold, this may be achieved through the same venipuncture and parenteral needle 63, simply by adjustment of valve 58 through handle 59 to disconnect manifold 46 and interconnect syringe 64 with terminal tubing 62, and then operating syringe 64, which is mounted in place ready for use. If it be desired to infuse blood or other fluid from bottle 72, this may be done at any time from bottle 72 through separate needle 75. If it be desired to infuse one or more liquids not mounted upon the ring 13 in the original setting up of the apparatus, this may be done as discussed above, merely by suspending the desired bottle from clip 69 and interconnecting it through the needle or needles 68 which are not originally interconnected with the bottles, but are nonetheless secured in the desired position in relation to their drip sights and connected tubing so as to be instantaneously available.

The invention provides very great advantages in connection with the use of a panel 18, having a plurality of holes 26 arranged so that the brackets 27, clips 65 and manifold 46 may be mounted in any desired position on the panel and in relation to each other. Thus, where operations are to be performed at the left of the apparatus, instead of at the right as illustrated in Figure 1, the positions of the manifold 46 and syringe 64 will be reversed.

It will be noted that, in the normal use of the apparatus as set up, it will remain sterile through the various

conduit and manifold connections. As a consequence, when an operation is completed and a new one is to be commenced, it will only be necessary to remove and discard the terminal tubing **62** and needle **63** and replace these by a new tubing and needle. This represents not only a saving in equipment but also a vast saving in time as compared to prior systems of operation.

The passages **49** and **52** of the manifold **46** extend in straight lines and are of relatively small capacity. In view of this fact, and especially in view of the fact that no pockets or traps exist within the body of the manifold for accumulation of liquid, there is little chance for the various liquids passed to and through the manifold to deteriorate or interact deleteriously with each other, and the fact that the capacity is maintained at a minimum also serves to fulfill the purpose of the invention by providing very prompt response to any change in liquids fed thereto or the rate of supply of such liquids through the proportioning and flow controlling clamps **36, 39**.

It will also be noted that, when it is desired to clean the manifold passages and associated parts, it will only be necessary to open up the connections at the various Luer fittings and at the valve **58**, and to pass a cleaning member such as a brush or pipe cleaner through the fittings **55** and **53** and valve **58**. The manifold may then be sterilized by autoclaving or boiling.

As noted above, the provision of the holes **26** also makes it possible to mount a second manifold **46** and terminal tubing upon the panel in a desired location, for interconnection to desired bottles through selected clamps and drip sights, and for use simultaneously with the first manifold or consecutively.

While the invention has been described only in relation to a single embodiment, it will be evident to persons skilled in the art that it may be modified and refined in various ways within its generic scope. I therefore wish to have it understood that this invention is not to be limited in interpretation except by the scope of the following claims.

I claim:

1. In an apparatus for administering parenteral liquids to a patient during an operation, the combination comprising a portable wheeled supporting structure, means mounted at the top of said structure for removably supporting a plurality of bottles containing different parenteral liquids, flexible conduits separately connected to said bottles and depending therefrom, a mounting panel structure secured to said supporting structure beneath the bottle mounting locations and provided with a large number of spaced mounting holes extending therethrough, securing clips mounted in spaced relation on said panel mounting structure, drip sights secured by said clips and interconnected individually with the flexible conduits depending from said bottles, flexible conduits depending individually from said drip sights, clamping means mounted in selected positions on said panel by studs extending through selected mounting holes, said flexible conduits depending from said drip sights being individually located by said clamping means in position for flow adjustment thereby, a manifold interconnected with the lower ends of said last-mentioned conduits through passages extending laterally into the interior of said manifold, said laterally extending passages being interconnected at their inner ends to a vertically extending passage extending from top to bottom of said manifold, a removable closure at the upper end of said manifold, a coupling at the lower end of said manifold interconnecting said vertically extending passage with a flexible terminal conduit, and valve means for controlling flow of liquid from said manifold through said terminal conduit.

2. An apparatus as defined in claim 1, including the further feature that securing clips for a syringe are also mounted upon said panel through selected mounting holes spaced from said clamp and manifold locations.

3. An apparatus as defined in claim 2 in which a syringe is mounted in said syringe securing clips and interconnected through a flexible conduit with said terminal conduit through said valve.

4. In an apparatus for administering parenteral liquids to a patient during an operation, the combination comprising a portable wheeled supporting structure, means mounted at the top of said structure for removably supporting a plurality of bottles containing different parenteral liquids, and a mounting panel structure secured to said supporting structure beneath the bottle mounting locations and provided with a large number of spaced mounting holes for securement thereto in selected positions of a plurality of tubing locating and flow adjusting clamps, and of a manifold for interconnection through plural inlets with tubing connections extending from said clamps, and a plurality of drip sight securing clips mounted above the clamp and manifold locations established by said holes.

5. In an apparatus for administering parenteral liquids to a patient during an operation, the combination comprising means for supporting a plurality of bottles containing different parenteral liquids at an elevated location above the operating position, a panel mounted below said supporting locations for said bottles, and clamping means mounted on said panel for flexible tubing depending from said bottles, each such clamping means comprising a V-shaped backing member having curved notches for receiving the tubing at the outer ends of the V portions, and a complementally shaped male clamping member mounted in position to abut said tubing member as so located and to pinch the same, and means for actuating said complemental member into the tube pinching position.

6. In an apparatus for administering parenteral fluids to a patient during an operation, the combination comprising a bottle support located at an elevated position above the operating position, a panel mounted below said bottle supporting position and provided with a large number of holes extending through its face, and a manifold provided with passages for receiving and dispensing liquids received through flexible conduits depending from said bottle supporting position, said manifold being provided at its rear with stud means extending through selected holes in said mounting panel to locate and secure the same upon said panel, said manifold including a plurality of straight and small capacity interconnected passages for interconnection with said conduits depending from a plurality of bottles at said bottle supporting position, and the body of said manifold being devoid of liquid pockets.

7. An apparatus as defined in claim 6, in which plural clamping means are mounted at selected locations above said manifold upon said panel by studs extending through selected holes in said panel.

8. In an apparatus for administering parenteral fluids to a patient during an operation, the combination comprising a bottle support located at an elevated position above the operating position, a panel mounted below said bottle supporting position and provided with a large number of holes extending through its face, and a manifold provided with passages for receiving and dispensing liquids received through flexible conduits depending from said bottle supporting position, said manifold being provided at its rear with stud means extending through selected holes in said mounting panel to locate and secure the same upon said panel, said support being provided with support for a plurality of bottles, said manifold including a plurality of interconnected passages for interconnection with tubing depending from a plurality of bottles at said bottle supporting position, and plural clamping means mounted at selected locations above said manifold upon said panel by studs extending through selected holes in said panel, and a plurality of drip sight securing clips mounted above said clamping means.

9. In an apparatus for administering parenteral fluids to a patient during an operation, the combination com-

prising a bottle support located at an elevated position above the operating position, a panel mounted below said bottle supporting position and provided with a large number of holes extending through its face, and a manifold provided with passages for receiving and dispensing liquids received through flexible conduits depending from said bottle supporting position, said manifold being provided at its rear with stud means extending through selected holes in said mounting panel to locate and secure the same upon said panel, support being provided for a plurality of bottles at said bottle supporting position, said manifold including a plurality of interconnected passages for interconnection with tubing depending from a plurality of bottles at said bottle supporting position, the manifold passages being of small capacity and straight, and the body of said manifold being devoid of liquid pockets.

10. In an apparatus for administering parenteral liquids to a patient during an operation, the combination comprising means for supporting a plurality of bottles containing different parenteral liquids at an elevated location above the operating position, a panel mounted below said supporting locations for said bottles, and clamping means mounted on said panel for flexible tubing depending from said bottles, each such clamping means comprising a backing member having tube receiving recesses at the outer ends thereof, and a clamping member, said backing member and said clamping member having complementally shaped tube engaging surfaces, said clamping member being mounted in position to abut said tubing member as located in said recesses and to pinch the same, and means for actuating said clamping member into the tube pinching position.

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